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THE ADVENT GROUP, INC.

Brentwood, Tennessee

MICROBIAL TOXICITY DETERMINATION FOR THE PORT READING, HOVIC, AND PURVIS REFINERIES

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Prepared for:

AMERADA HESS CORPORATION
Woodbridge, New Jersey

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January 13, 1987 2107

T. Helfgott, Ph.D., P.E.
Amerada Hess Corporation
One Hess Plaza
Woodbridge, NJ 07095

Subject: Microbial Toxicity Determination for the Port Reading, HOVIC, and Purvis Refineries.

Dear Dr. Helfgott:

The enclosed report summarizes the proposed microbial toxicity determination for the Port Reading, HOVIC, and Purvis Refineries. The serial dilution respirometer test is recommended as indigenous soil microorganisms are used for the inhibition evaluation. Other methodologies, such as the Microtox System, are not applicable as they utilize foreign microorganisms (i.e., marine phytoplankton) not present in the land treatment units. We feel the proposed methodology will generate the most accurate assessment of the toxicity test application rate.

Please feel free to contact us at (615) 377-4775 with any questions or comments concerning this report.

Sincerely,

The ADVENT Group, Inc.

Jane T. Red

Jane T. Red, CPSS
Soil Scientist

Michael R. Corn

Michael R. Corn, P.E.
Principal

EXECUTIVE SUMMARY

Microbial toxicity is defined as that application level at which waste becomes inhibitory or toxic to the soil microorganisms responsible for biological waste degradation. Toxicity tests are performed on waste sludges applied to land treatment units to determine the microbial toxicity level of waste application. Although a wide variety of toxicity tests are acceptable to the regulating authorities, those tests which simulate actual field conditions, (that is, indigenous soil microflora, soil types, hydrologic conditions, waste types and applications rates), will generate the most realistic assessment of site specific microbial toxicity. The proposed toxicity test included in this report is a serial dilution respirometer test perpformed on acclimated soil/sludge mixtures. Unlike other microbial toxicity determination methodologies, such as the "Microtox" test, the respirometer test utilizes indigenous soil microorganisms to evaluate toxicity. By simulating field conditions as closely as possible, the serial dilution respirometer test will generate accurate, site specific predictions of microbial toxicity for each land treatment unit.

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INTRODUCTION

The biological treatability of a waste is defined as that property of the waste which permits its assimilation and utilization by microorganisms. A critical component of the biological treatability of a waste is the determination of microbial inhibition or toxicity, or the application level at which the waste becomes inhibitory or toxic to soil microorganisms. The evaluation of microbial toxicity enables the land treatment system operator to manage the system so that biological degradation is maximized.

STUDY GOALS

The requirements of 40 CFR 264.271, 264.272, and 264.273 specify that the treatment program includes:

> "design measures and operating practices necessary to maximize the success of degradation, transformation, and immobilization processes in the treatment zone" (40 CFR 264.271 (a)(2)).

EPA guidance on Land Treatment Demonstrations recommends that toxicity tests be run on waste sludges applied to the land treatment unit (landfarm) in order to determine if there is some application level at which the wastes are toxic to the soil microbial populations. The Treatment Demonstration requirements specify in 40 CFR 264.272:

> "(c) Any field test or laboratory analysis conducted in order to make a demonstration under paragraph (a) of this section must:
>
> 1. Accurately simulate the characteristics and operating conditions for the proposed land treatment unit including:
>
> (i) The characteristics of the waste (including the presence of Appendix VIII of Part 261 of this chapter constituents);

(ii) The climate in the area;

(iii) The topography of the surrounding area:

(iv) The characteristics of the soil in the treatment zone (including depth); and

(v) The operating practices to be used at the unit.

2. Be likely to show that hazardous constituents in the waste to be tested will be completely degraded, transformed, or immobilized in the treatment zone of the proposed land treatment unit; and

3. Be conducted in a manner that protects human health and the environment considering:

(i) The characteristics of the waste to be tested;

(ii) The operating and monitoring measures taken during the course of the test;

(iii) The duration of the test;

(iv) The volume of waste used in the test;

(v) In the case of field tests, the potential for migration of hazardous constituents to ground water or surface water."

The laboratory tests are designed to simulate actual soil conditions, waste types and application rates practiced, and to provide optimum environmental conditions (pH, nutrients and moisture) so that any toxicity effects can be identified without other interferences.

PROPOSED TOXICITY TEST

The proposed toxicity tests for the HOVIC, Port Reading, and Purvis refineries of the Amerada Hess Corporation are laboratory respirometer toxicity tests. The laboratory tests are to be set up to simulate typical waste applications that are used at the three refineries, as well as a higher

application rate (potential toxicity range). Acclimated soils from each of the landfarms will be used as the soil dilution source. Various waste composites will be made up which reflect normal waste ratios applied to the landfarms. A separate test will be run on certain wastes (such as, Beavon froth, and biological solids) which are nonhazardous and different from the oily wastes (such as DAF float, API Separator sludges, slop oil tank emulsions and tank bottoms) applied to the landfarms.

An important criteria in performing toxicity investigations or any oxygen demand type test is to ensure that an acclimated biological seed is used. The use of soils from the zone of incorporation of the landfarms at each refinery should ensure that acclimated microbial populations to the waste types are available in the test.

LABORATORY METHODOLOGY

Soil samples will be collected from the zone of incorporation (dilution soils) at each refinery landfarm. Prior to each toxicity determination, the dilution soils and sludge composites will be independentally analyzed for oil and grease content, total organic carbon, total nitrogen, pH, conductivity, and total phosphorus. The soils will also be physically classified (USDA soil classification). The soil pH and the Total Organic Carbon to Total Nitrogen ratio will be adjusted in the serial dilutions so that the potential toxic effect of sludge additions can be determined without interference from other adverse conditions. Soil moisture and soil temperature will also be kept constant in each test.

A serial dilution Biochemical Oxygen Demand test will be conducted for two composite sludge samples from each refinery.

Port Reading:

Composite #1:	API, Tank Bottoms, Slop Oil Tank Bottoms
Composite #2:	Composite #1 plus Biological Sludges

HOVIC:

Composite #1:	API, Heat Exchanger, Leaded Tank Bottoms
Composite #2:	Composite #1 plus Beavon Froth

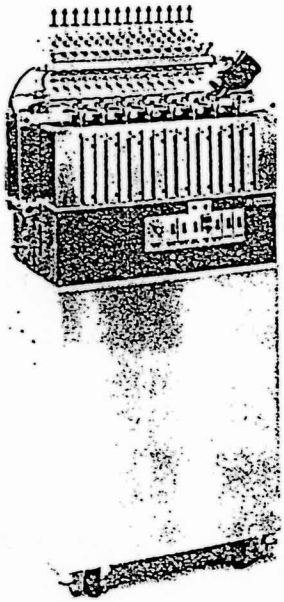
Purvis:

Composite #1:	API and DAF
Composite #2:	Composite #1 plus Nitrogen source

For each composite sample, at least three to five dilution levels will be analyzed in triplicate. The dilution levels preliminarily suggested are the equivalent of 0, 1, 2, 4 and 6 inch sludge applications to the zone of incorporation (dilution soils) from the specific refinery landfarm (3 separate dilution soils to be used; each representing acclimated soils for the particular refinery from which the waste composites have been obtained). These dilutions may be changed based on the chemical characterization of the waste composites. The wastes will be applied to the dilution soils in a separate container. The wastes will be added so that a definitive sludge layer such as one inch of sludge rests on top of the dilution soils. The wastes will then be mixed in with the dilution soils. A specific volume of soil/waste mixture will then be placed in the respirometer test chambers. These samples will be analyzed for at least seven days using a respirometer device such as a Gilson Differential Respirometer, Warburg or Hach Manometric BOD apparatus as shown in Figures 1 through 5.

DATA ANALYSES

The microbial toxicity level will be determined from plots of the respiration data (converted to cumulative oxygen uptake) over the seven day



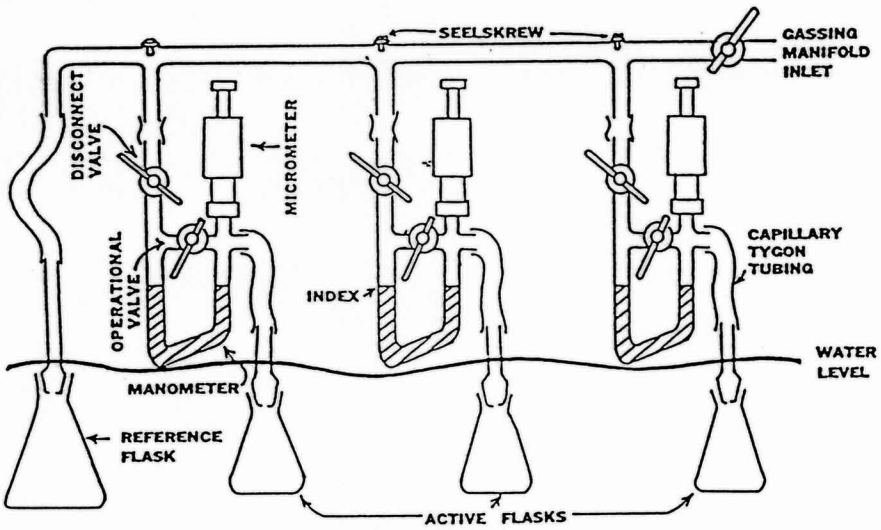
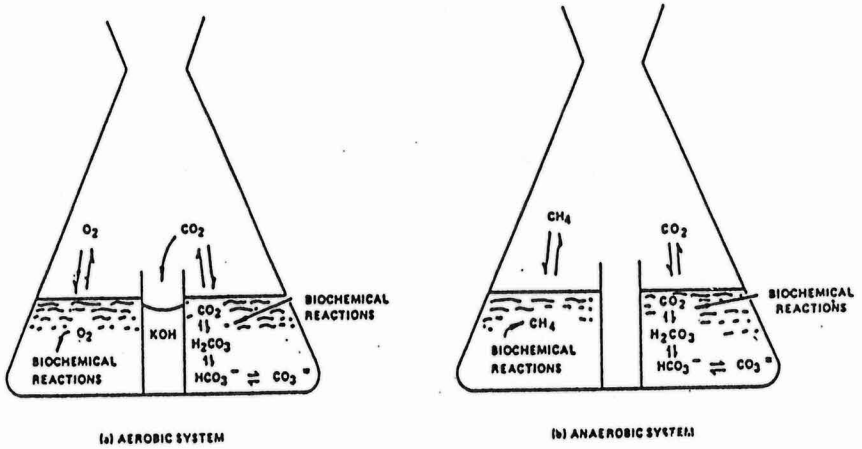
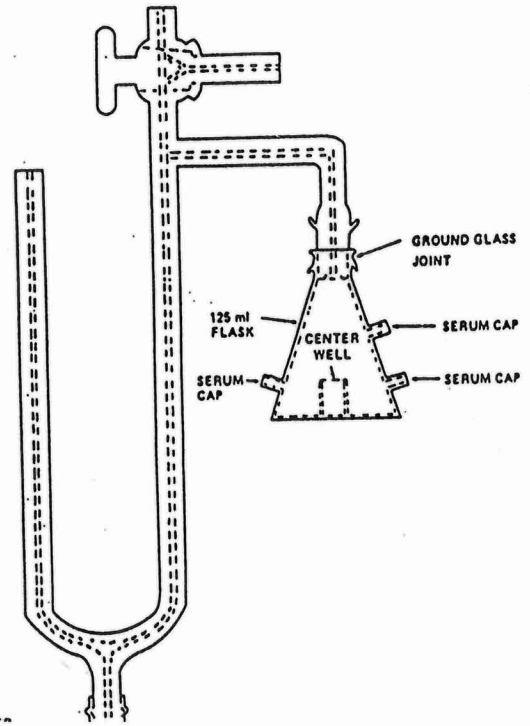


FIGURE 1

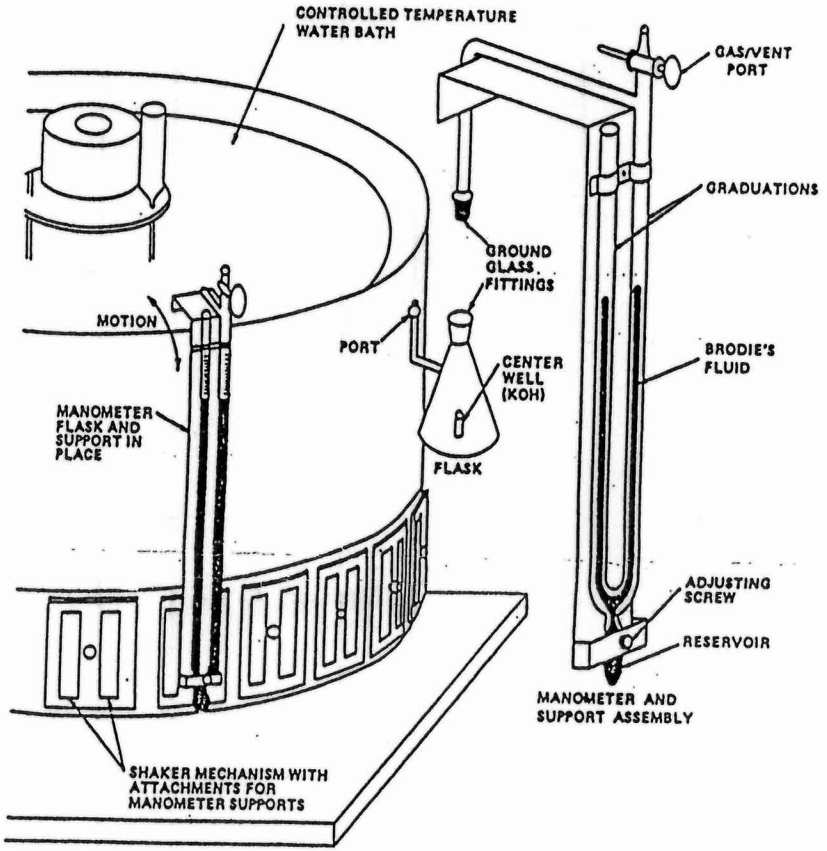
GILSON DIFFERENTIAL RESPIROMETER



REACTION FLASKS



SCHEMATIC OF FLASK



COMPLETE APPARATUS

FIGURE 2

WARBURG RESPIROMETER

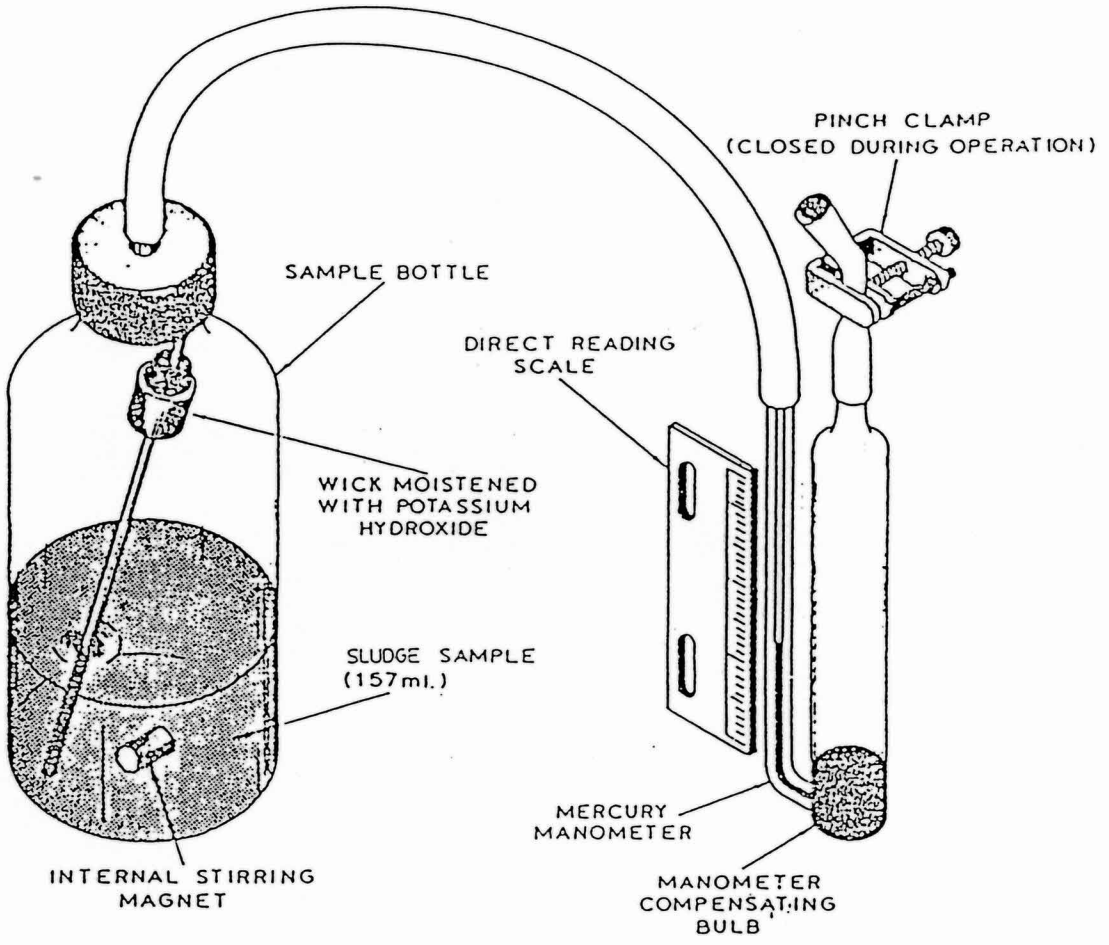


FIGURE 3

DIAGRAM OF HACH MANOMETER BOD APPARATUS

period as demonstrated in Figure 4. If inhibition is indicated, an attempt will be made to analyze the test data using Lineweaver-Burk plots or equivalent plots as shown in Figure 5 to determine if there is a competitive inhibitor (such as a complex organic) or a noncompetitive inhibitor (such as metals).

Microbial toxicity levels for each refinery will be used in conjunction with degradation rate determinations, immobilization potentials, volatilization, and unsaturated zone monitoring, to determine if the typical waste applications to the landfarms exhibit toxicity to the soil microbial population. These determinations will demonstrate if maximum and minimum seasonal loading rates for each landfarm can be accomplished without bacterial toxic effects. The current loading rates at the landfarms are around 1 to 4 percent oil and grease. About 8 percent oil and grease is the maximum that can be managed (landfarm can be worked with a tractor at this level) and therefore 8 percent oil and grease would be the maximum concentration considered for testing. The dilutions used in the toxicity tests will include those typical of current practices.

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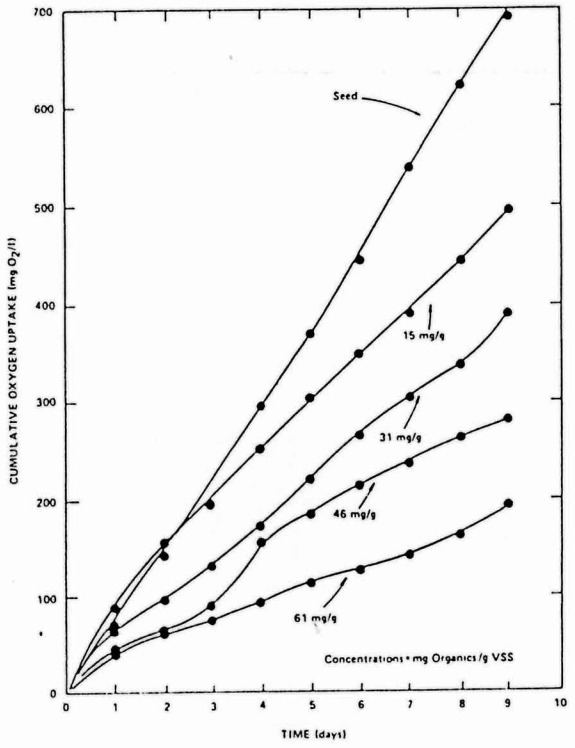
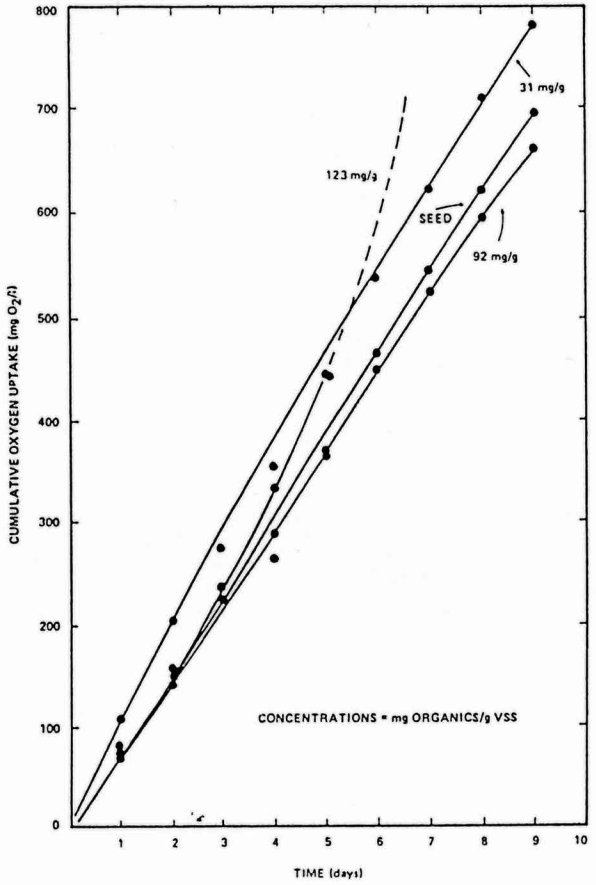
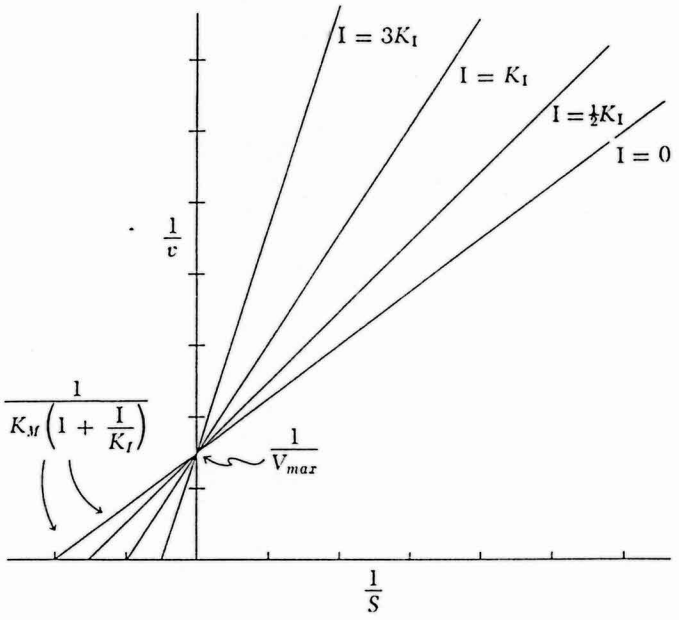


INHIBITED WASTE

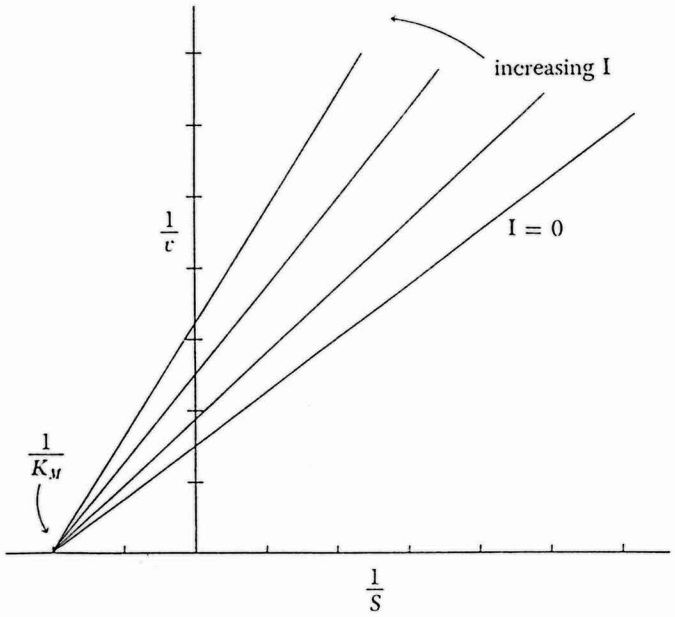


NON-DEGRADABLE NON-INHIBITED WASTE

FIGURE 4
WARBURG DATA



COMPETITIVE INHIBITOR



NONCOMPETITIVE INHIBITOR

FIGURE 5

LINEWEAVER–BURK PLOTS